ATTACHMENT - REMARKS

The interview held with the Examiner Nguyen on August 28, 2008, is gratefully acknowledged. The courtesy and cooperative spirit shown by the Examiner to the inventor, Peter Foster, and his representative, is appreciated. The interview centered around the rejection on prior art and a summary is provided in the Interview Summary provided by the Examiner. The discussions at the interview are also incorporated in the remarks which follow.

Considering the matters raised in the Office Action in the same order as raised, the specification has been objected to as failing to provide proper antecedent basis for the claimed subject matter. The Examiner contends that "the subject matter claimed in claim 34, however, is entirely different from what is disclosed." This contention is respectfully traversed.

As the Examiner has appreciated, claim 34 is based on the fourth embodiment. Page 24 from line 15 states that:

> "According to a fourth embodiment, a synchronous trigger signal for a transducer on a given device is produced by using the SOF packet including the encoded frame number, to trigger a transducer at a given time."

This clearly teaches a method whereby a trigger signal (viz. physical action) is generated when the device receives an SOF packet with a specific frame number. The person of ordinary skill in this art will immediately understand that reference to a trigger signal implies the use of a "trigger request signal" to "initiate" or pre-configure the device

to perform its action (i.e. be triggered) upon receipt of a specifically numbered SOF packet. Though not referred to explicitly in the context of the fourth aspect of the invention as filed (being regarded as implicit), reference is made to a "trigger request signal" earlier in the summary of the invention (see page 13 lines 28 and 29) in a manner that distinguishes it from a trigger command signal.

Also, the trigger request signal is merely a message that configures the device to act upon receipt of the trigger command signal. The trigger command signal (explicitly recited in the claims as filed regarding this aspect of the invention) is emphasized because it is that signal that is actually decoded from the data stream. An SOF packet is not adapted to contain information about what action to take and hence the trigger command signal, as it is a packet defined by the USB specification and so essentially reserved. It would thus be readily understood by those of ordinary skill that, if the SOF packet generates the trigger command signal, an earlier message (in fact the trigger request signal) must have been sent to define what action to take on receipt of the trigger command.

Thus, the brief summary of this aspect of the invention would nonetheless be understood to imply the use of a trigger request signal. In any event, claim 34 as filed refers explicitly to the trigger request signal, and present claim 34 as amended is clearly based on that disclosure.

Furthermore, the specification clearly teaches the synchronisation of a plurality of devices according to this aspect of the invention. As explained from page 24, line18:

> "However owing to the USB connection topology, the arrival times of the SOF packet can differ between devices and, in addition, the USB specification allows

significant temporal jitter in the SOF packet frequency with respect to the phase locked oscillator."

From page 24 line 28 it is explained that:

"To eliminate the problems of jitter the SOF signal is latched to the local oscillator."

And from page 24 line 37 the application as filed states that:

"Thus, figure 6 is a schematic diagram of a circuit 70 for monitoring the USB 72 and locking the clock signal (phi) from a local clock 74 (with output frequency downshifted to 1kHz – if necessary – by clock frequency divider 76) to the 1kHz SOF packet of USB 72 in frequency and phase."

The Examiner is also concerned that the specification does not support a trigger request signal being indicative of an initiating trigger request (but rather "transmitting a predetermined trigger request signal and a predetermined trigger command signal in the USB data traffic, indicative respectively a trigger request and said trigger command"). However, page 14 lines 2 to 4 of the original specification defines "configuring said USB devices to respond to said *initiating trigger request signal* by preparing themselves to perform said processes on receipt of said trigger signal". The "initiating trigger request signal" was intended to convey a trigger request signal configured to initiate a process, so the word "initiating" was merely intended to indicate that what was referred to was a

"trigger request signal" that *initiates* the process. The actual signal was simply a "trigger request signal", so "initiating" was deleted in a previous submission. As was discussed during the interview, the word "initiating" has now been deleted in claim 34.

The Examiner is concerned that "transmitting said trigger request signal... to prepare said plurality of USB devices to each initiate said initiating trigger request" differs from the originally disclosed "sending and initiating trigger request signal... to prepare said USB devices to executive said trigger request", and that the original language appears to distinguish between "a trigger request signal" and an "initiating trigger request signal". As discussed above, these are the same feature: a trigger request signal is by implication "initiating." However, as indicated above, the claims have been amended to delete the word "initiating."

The Examiner also objects to the order in which the "monitoring" step appears in claim 34.

In the claimed method, monitoring or watching for the arrival of the signal occurs before the signal is expected to be there. The Examiner argues that claim 34 implies that the method involves monitoring the USB traffic for signals that have not yet been transmitted. However, this is, indeed, generally correct: the step of "monitoring traffic local to each of said plurality of USB devices for a trigger request signal and for a trigger command signal" is defined before "transmitting said trigger request signal... to each of said plurality of USB devices," because monitoring or watching for the arrival of the signal may commence before it is expected to arrive.

For this reason, claim 34 refrains from specifying the relative order of these two steps. The Examiner has possibly read this step as "monitoring the signal", so

objected that one cannot monitor something that has not yet been generated. The claim actually recites "monitoring… *for* a trigger request signal and *for* a trigger command signal" (emphasis added), which has essentially the meaning of "watching out for" the signals.

In any event, it is respectfully submitted that the position of this step in claim 34 is suitable and indeed reflects the more common sequence in which the steps will be initiated.

The Examiner again objects to claim 34 wherein the claim recites monitoring traffic local to each of the plurality of USB devices "for a trigger request signal and for a trigger command signal, indicative respectively of an initiating trigger request and of a trigger command". The Examiner asserts that the quoted passage is unclear, and that there is insufficient information in the specification for it to be understood. This assertion is respectfully traversed.

As is well understood in this art, a trigger request signal prepares a device to receive a trigger command. It might be compared to "arming" an oscilloscope to receive a trigger signal. It is a preparatory command that sets the device into a specific state. The trigger command might be described as the "go" command. Claim 34 employs these two terms consistently in this well understood manner, and would be understood by those of ordinary skill in this art.

The Examiner contends that claims 35 and 37 suggest that the trigger command signal comprises the same element as does the trigger request signal. As a result, the Examiner is uncertain whether there is any difference between these signals, and how a

trigger command signal or a request signal can include only USB packet signal structure or data sequences.

Considering these issues, the trigger request and trigger command signals can be defined to be any command or data sequence allowed within the USB specification. The present application does not state that they should be identical. They are two distinct commands but each may comprise any such command or data sequence; nonetheless, they must both be adapted to perform their respective functions so if any particular combination prevents them from providing that functionality, that combination is excluded from the scope of claim 34, and hence claims 35 and 37, by the functions defined in claim 34 as performed by those signals.

It is respectfully submitted, therefore, that these claims are clearly in accordance with 35 U.S.C. 112, second paragraph.

Finally, in addition, as requested by the Examiner during the interview, a table has been prepared and is submitted herewith which maps the language of claims 32, 33 and 34 on the specification. It is noted that the Examiner made specific reference to claim 34 but it is believed that the core objection the Examiner here has been overcome by the amendments that have been made to claim 34.

Turning to the rejection on prior art, claims 32 and 33 have been rejected under 35 U.S.C. 103(a) as being "unpatentable over Crutchfield et al., U.S. Patent Publication No. 2002/0196884, Greco et al., U.S. Patent No. 7,081,583, Cho, U.S. 6,954,506, Brief, U.S. Patent No. 6,678,760, in view of Lee et al., U.S. Patent No. 7,174,475, and further in view of Dreps et al., U.S. Patent No. 6,654,897."

Firstly, Greco *et al.*, US 7,081,583 is not prior art for this application, and so it is respectfully submitted that the rejection based on that document should be withdrawn.

The Examiner contends that Crutchfield (US 2002/0196884), Cho (6,954,506) and Brief (US 6,678,760) teach locking the frequency of the clock of a USB device to a predetermined degree and, if applied to a USB tree, would allow all clocks to be synchronized.

Crutchfield teaches a method for ensuring that data in a USB packet is sampled at the center of the "data valid" window. This comprises a method for selecting a clock edge for starting the serial-to-parallel transfer of the USB Serial Interface Engine. The reference discloses on page 4:

> "[0042] The synchronisation pulse SPG_PULSE generated by synchronous pulse generator 14 is used to synchronise the logic in serial interface engine 16 for extraction of data from difference signal RXD and for the conversion of the serial difference signal RXD into a parallel format to generate parallel data P_DATA.
>
> "[0043] The maximum USB data jitter is 20ns from transition to transition. Therefore, the data must be captured near the centre of the bit period. This is accomplished by aligning synchronisation pulse SPG_PULSE a certain number of clock periods after a change in the difference signal RXD."

However, this is not relevant to synchronizing a general clock in a USB device, but rather is merely concerned with data extraction from a received packet.

Choi discloses a method for data clock recovery from a USB data stream. This document is concerned with decoding the USB packet "sync" field for the purpose of decoding the payload data of the packet. This is a fast locking circuit for capturing data, and synchronisation is only transient. The process of clock data recovery synchronisation begins again only upon receipt of the next data packet. Column 1, line 67 states that: "USB 2.0 requires the USB receiver to recover a clock signal within a short preamble, that is, within a 4-clock period" and, from column 4, line 53, it is explained that: "The RXCX signal is a clock signal having the same frequency as that of a clock signal used to transmit the R_DATA signal from a USB transmitter." From column 5, line 55 US 6,954,506 further explains that: "Indeed, a clock signal recovery circuit according to the present invention can obtain a clock recovery signal synchronized with the received data..."

Thus, the Cho reference merely relates to the field of data clock recovery, not to synchronization of a general clock in a USB device.

Brief discloses a method of delaying data packets sent and received through an Isochronous transfer, and teaches a double buffering method for synchronizing the delivery of data packets across the USB. The suggested applications are in synchronizing telephony and video signals across USB, whereby data packets are received, buffered and delivered. Brief also discloses a method for synchronising the clock rate of the USB host controller to a reference clock rate, which is merely a part of the USB specification and general Host Controller configuration documentation.

None of these references can be applied to a USB tree because, firstly, the clock data recovery techniques of Crutchfield and/or Cho only synchronise the clocks for long enough to recover data from one packet.

A High Speed USB 2.0 packet has a maximum data payload size of 1024 bytes, plus three bytes of handshaking. At a bus speed of 480Mb/s this means that the maximum packet duration is 17.2 microseconds. This is the maximum time that the clock data recovery inventions need to maintain clock lock. Synchronisation is lost within several packet times. The process of data synchronisation starts again from scratch with the receipt of the next packet.

Also, these citations would in no way suggest a clock locking scheme to someone of ordinary skill in this art, whether as claimed in the present application or otherwise.

Brief relates to USB transmissions using the Isochronous transfer mode. Isochronous mode reserves a guaranteed bandwidth for each device but does not provide any protection for corrupt data. If a packet is corrupted, then data is lost, which is unacceptable for many applications. Brief teaches a way of delaying a data packet within a USB device by double buffering, which is a clever way to achieve a modicum of synchronisation between delivery of packets in one USB transfer mode. However it would not work in other modes and however combined with the two references discussed above would not lead to the claimed method of clock synchronisation across a USB tree.

The second part of Brief teaches a method of controlling the rate of a USB host clock by comparing it to a reference clock on one attached USB device. The present invention does not rely on controlling the rate of the USB host clock.

The Examiner contends that it would have been obvious from Lee to determine the relative propagation delay from a master USB device from a slave USB device. The applicants respectfully disagree. Lee teaches a method of determining propagation delay by providing a "loop-back" path for a clock signal and measuring the round trip propagation time. This is a very simple system where one wire carries the actual clock signal out and another wire carries the signal back.

However, USB is a serial communication bus. There are no "clock" signals that are transmitted by the master device, and definitely no means by which such a clock signal can be sent back for measurement of round trip time. Only data packets are communicated across the USB. It would therefore be far from obvious to someone of ordinary skill in the art to contemplate such a "round trip" time measurement, let alone determine how it might be implemented.

In an illustrative embodiment of the present invention, a specific communication packet (essentially a message) is designated as the outgoing signal, and is used to start the timing process. The message is received by the USB device and processed internally. The USB processes the message and provides a response message which is used to stop the time measurement process back at the upstream point. This is a communication protocol and not a simple feedback of a clock signal on a wire; indeed, several months of research by the applicants were required simply to determine

whether this approach would work. It is respectfully submitted that this approach is by no means obvious.

Concerning the Dreps reference, Dreps discloses a method of delaying multiple data signals on a bus receiver and adjusting the bus clock such that the data is centered on the "data valid" window. The reference does not relate to synchronizing clocks on multiple devices.

It is also respectfully submitted that the person of ordinary skill would not combine the references as suggested by the Examiner. The references all teach distinct inventions with diverse characteristics that are not readily combined, and which would not be considered by the person of ordinary skill as usefully supplementing each other.

For the reasons set forth above, it is respectfully submitted that claim 32 is patentable over the cited art.

With respect to the dependent claims, it is respectfully submitted that these claims are patentable over the cited art for at least the reasons set forth above in support of the patentability of claim 32.

Allowance of the application in its present form is respectfully solicited.

Respectfully submitted,

Date: October 30, 2008

Signed By
Attorney of Record

Name: Ross F. Hunt, Jr.
Registration No.: 24082

STITES & HARBISON PLC ◆ 1199 North Fairfax St. ◆ Suite 900 ◆ Alexandria, VA 22314
TEL: 703-739-4900 ◆ FAX: 703-739-9577 ◆ CUSTOMER NO. 881

CLAIMS:	Support:
32. (Currently Amended) A method of synchronizing a plurality of local clocks of a plurality of USB devices, <u>each of said plurality of local clocks corresponding to a respective one of said plurality of USB devices</u>, the plurality of USB devices being connected to a common USB host via a USB tree so that said plurality of local clocks of said plurality of USB devices are in phase and at a common frequency, comprising:	"Each device 106 may contain a local clock that is frequency and phase locked according to the above-described second embodiment." [page 26 line 37 to page 27 line 3]
transmitting by the common USB host to each of said plurality of USB devices one or more first specific signal structures;	page 10 lines 5 to 8
monitoring local USB signals at each of said plurality of USB devices for said one or more first specific signal structures;	page 10 lines 9 to 10
generating a plurality of local reference signals, each local reference signal corresponding to each respective one of said plurality of USB devices, <u>each local reference signal being generated by each respective one of</u>	page 10 lines 23 to 29 & page 10 lines 11 to 12 "Thus, according to a second embodiment of the invention, the USB traffic is observed, and

said plurality of USB devices from at least one of said one or more first specific signal structures received at each of said plurality of USB devices;	*the USB device's local clock signal* is locked to the USB SOF packet in phase and frequency." [page 19 lines 24 to 27]
locking a plurality of frequencies of said plurality of local clocks at said plurality of USB devices, each frequency corresponding to a respective one of said plurality of local clocks, and each frequency being locked to each corresponding one of said plurality of local reference signals to a predetermined degree;	page 10 lines 13 to 15 "*Each* device 106 may contain a local clock that is frequency and phase locked according to the above-described second embodiment." [page 26 line 37 to page 27 line 3]
designating a USB device in said USB tree as a master USB device for monitoring USB data traffic to and from each of said plurality of USB devices;	page 7 lines 28 to 32 and page 11 line 11
transmitting by the common USB host one or more second specific signal structures to each of said plurality of USB devices and transmitting specified response signals corresponding to said one or more second specific signal structures from each of said plurality of USB devices;	page 11 lines 12 to 15; "According to this embodiment, the roundtrip propagation time of a specific data packet from Host to Device and the associated USB acknowledgement ACK TOKEN from the Device for each device present are measured." [page 21 lines 17 to 21]
monitoring for said one or more second specific signal structures and for said specified response signals with said master USB device;	page 11 lines 16 to 18
generating first event triggering signals	page 11 lines 19 to 21

local to said master USB device corresponding to decoding of at least one of said one or more second specific signal structures;	
generating second event triggering signals local to said master USB device corresponding to decoding of said specified response signals from said plurality of USB devices;	page 11 lines 22 to 24
measuring respective time intervals between said first and second event triggering signals for said plurality of USB devices, each time interval corresponding to each one of said plurality of USB devices;	page 11 lines 25 to 26
determining a plurality of relative propagation times <u>with respect to a reference USB device selected from said plurality of USB devices</u>, each relative propagation time corresponding to each one of said plurality of USB devices other than a reference USB device selected from said plurality of USB devices, each relative propagation time being determined with respect to said reference USB device by determining a difference between the time interval of said reference USB device and the time interval of each corresponding one of said plurality of USB devices other than said reference USB device;	"determining the relative propagation delay of signals from said USB host to each of said USB devices *with respect to a selected one of said USB devices according to the method described above*, said selected one of said USB devices designated *a reference USB device;*" [page 12 line 34 to page 13 line 1] Also, page 12 line 8, 13 to 24 and page 13 lines 2 to 5

determining whether a temporal adjustment or phase offset is required for each local clock of said plurality of local clocks to result in said plurality of local clocks being in phase;	page 13 lines 6 to 9
for each local clock requiring a respective temporal adjustment or phase offset, transmitting said respective temporal adjustment or phase offset to each corresponding USB device of said plurality of USB devices; and	page 13 lines 10 to 11
adjusting the phase of each local clock requiring a temporal adjustment or phase offset on the corresponding USB device according to said respective temporal adjustment or phase offset.	page 13 lines 12 to 14
33. (Currently Amended) A method as claimed in claim 32, wherein at least some of said plurality of local clocks are shifted in phase by a desired amount.	[implicit in view of "said local *clocks*"]
34. (Currently Amended) **A method for synchronously triggering and thereby initiating or stopping one or more processes, comprising:**	page 13 lines 21 to 23
synchronizing said plurality of local clocks of	page 13 lines 26 to 27

said plurality of USB devices according to the method of claim 32;	
monitoring traffic local to each of said plurality of USB devices for a trigger request signal and for a trigger command signal, indicative respectively of ~~an~~ ~~initiating~~a trigger request and of a trigger command;	page 13 lines 32 to 34
transmitting said trigger request signal with said USB host to each of said plurality of USB devices to prepare said plurality of USB devices to each execute said ~~initiating~~ trigger request;	page 13 lines 35 to 37
configuring said plurality of USB devices to respond to said trigger request signal by configuring themselves to perform said one or more processes upon receipt of said trigger command signal;	page 14 lines 2 to 4 "initiating or stopping one or more processes" [page 13 lines 22 and 23]
transmitting said trigger command signal with said USB host to each of said plurality of USB devices; and	"configuring said USB host to issue said trigger command to each of said plurality of said USB" [page 14 lines 5 to 6]
decoding said trigger command from said trigger command signal with each of said plurality of USB devices and thereby configuring said plurality of USB devices to initiate or stop said one or more processes at a common time;	page 14 lines 7 and 8 page 14 lines 9 and 10

whereby said one or more processes can be initiated or stopped upon receipt by said plurality of USB devices of said trigger command signal from said USB host.	page 14 lines 11 to 13